PNW-348

March 1980

MANAGING LOGGING RESIDUE UNDER THE TIMBER SALE CONTRACT

by

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ABSTRACT

Management of logging residue is becoming an important part of timber sale planning. This involves controlling the amount of residue remaining on the ground and its distribution by diameter size class. Some residue is beneficial.

An interdisciplinary team specified a desired residue level for one clearcutting unit of this trial. For comparison another cutting unit was given a specified residue level approximately 30 percent greater, and another unit 30 percent lower.

KEYWORDS: Residue management, stumpage sales arrangement.

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INTRODUCTION

Forest managers are giving increased attention to management of logging residue. This includes not only reduction of residue to a manageable level, but also recognizes the need to leave some of the biomass on the ground for nutrient recycling, soil protection, seedling protection, and wildlife use.

Two steps were involved in this residue management trial; first, determining the desired residue level and second, carrying out the residue reduction to the desired level through the timber sale contract. The trial was undertaken during 1975-77 on the Wind River Experimental Forest, Gifford Pinchot National Forest, near Carson, Washington.

The trial sale was also designed to develop comparative production rates and costs for residue yarding. Those results are reported in another research note.

DESCRIPTION OF TRIAL SALE OFFERING

This trial was a part of the experimental Trout Creek Hill timber sale, in old-growth western hemlock, Douglas-fir, and Pacific silver fir, at an elevation of approximately 1,800 feet and on nearly level ground.

SALE BY CUBIC-FOOT MEASURE

Timber on the three cutting units of this sale covered by the residue level prescription was sold on a cubic-foot basis. All logs removed were scaled by the Columbia River Log Scaling and Grading Bureau at the High Bridge scaling station, under cubic-foot scaling instructions developed for this sale.

DETERMINING THE DESIRED RESIDUE LEVEL

An interdisciplinary team was assembled during timber sale preparation to determine a desired residue level in each of three diameter classes, designed to meet prescribed forest land management objectives. Team members were guided by a photo series illustrating a wide range of residue levels.[1] The team consisted of staff specialists from the Regional Forester's Office (Region 6) and the Gifford Pinchot National Forest Supervisor's Office, having skills in landscape management, soils, silviculture, wildlife management, and fire management. Each person was asked to specify a desired residue level, by diameter class. These residue levels were then reviewed by the team as a whole, and a consensus reached for a single prescription in each of the three diameter classes, expressed in tons per acre. These levels, with minor adjustment, were specified for Unit 2 of the timber sale. Levels approximately 30 percent lower were specified for Unit 1, and approximately 30 percent higher for unit 3 (table 1, fig. 1).

Prospective purchasers were advised that reaching the specified residue levels in the 1/4 to 3-inch diameter class on Units 1 and 2 might require stage logging, minimum bucking, and/or yarding of up to 100 percent of tops concurrent with regular log yarding, and on Unit 3 might require yarding of 50 percent of tops concurrent with regular yarding.

Specifications were shown in both cubic feet per acre and tons per acre, although in practice tons per acre became the primary reporting unit. Tons per acre were calculated by an adaptation of the planar intersect method for measuring forest residues.[2] All weights represent oven-dry tons.

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[1]Maxwell, Wayne G., and Franklin R. Ward. 1976. Photo series for quantifying forest residues in the: coastal Douglas-fir-hemlock type and coastal Douqlas-fir-hardwood type. USDA For. Serv. Gen. Tech. Rep. PNW-51, 103 p., illus., Pac. Northwest For. & Range Exp. Stn., Portland, Oreg.

[2]Brown, James K. 1974. Handbook for inventorying downed woody material. USDA For. Serv. Gen. Tech. Rep. INT-16, 24 p., illus. Intermtn. For. & Range Exp. Stn., Ogden, Utah.

Table 1--Specified residue level by diameter class

Unit	Diameter class			
	1/4-3"	3.1-9"	Over 9"[1/]	Total
	Cubic feet per acre (Tons per acre)			
1	290-440 (4-6)	290-580 (4-8)	0 (0)	580-1,020 (8-14)
2	360-660 (5-9)	440-800 (6-11)	<730 (<10)	<2,190 (<30)
3	580-950 (8-13)	580-1,020 (8-14)	<1,460 (<20)	<3,430 (<47)

[1/]Material in this size class is defined as those pieces firm enough to permit lifting and moving by choker and cable systems.

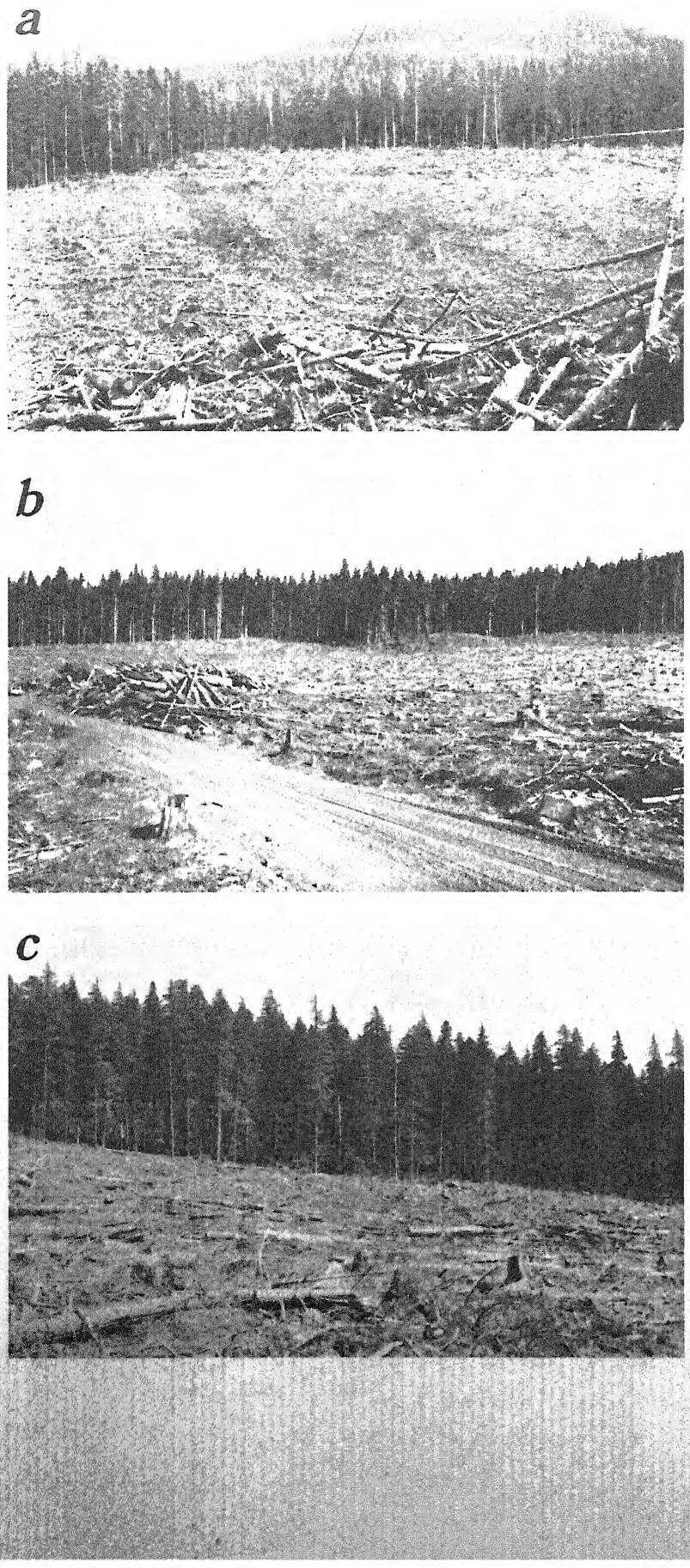

Figure 1.--Unit 1 (a), Unit 2 (b), and Unit 3 (c) after yarding to specified residue levels.

CONDUCT OF OPERATIONS

A study plan was made a part of the timber sale contract. This explained the residue management aspects and outlined responsibilities of both purchaser and Forest Service in carrying out the studies.

In cutting Units 1, 2, and 3 it was the purchaser's responsibility to remove material down to the specified residue levels, by cable yarding, without burning. The study plan called for unutilized material 6 inches and larger in diameter inside bark and 8 feet or more in length to be piled at the landing. Unutilized smaller pieces, whose removal was required to meet the specified residue levels, were yarded to the outer edge of the landings.

The Forest Service had responsibility to inventory residue levels every few days and to inform the purchaser of results. Each sampling area was expected to meet compliance with the upper limit of the specified residue level, but lower level limits were used only as a guide. That is, if the upper limit were exceeded, the purchaser would have to return and remove more material from the same sampling area; but if there was less than the minimum, no action was required.

Purchaser of the sale was Stevenson Co-Ply, Inc., of Stevenson, Washington. From the start it was recognized that meeting the specified residue levels on Units 1 and 2 would require yarding of some or all of the tops, with the main branches still attached. The operator, Ober Logging Company, commenced yarding with 90- and 100-foot towers, using the standard high-lead cable system. Later, a smaller yarder with a 70-foot tower was added so as to release the larger equipment for other use.

Terrain was nearly level, and the towers provided little or no lift beyond about 200-foot yarding distance. This resulted in tops being broken up during the yarding operation. Species composition was mostly western hemlock, and the brittle branches tended to break off either in felling or yarding. Yarding tops or branches along with regular logs slowed production and caused congestion and delays at the landing.

Several methods were tried to improve operations. These included using a crawler tractor to provide a short elevated tail hold, tight-lining within limits of the high-lead yarding equipment, rigging the tail block 30 to 40 feet high in a green tree, tree-length logging with tops left attached, and use of a brush grapple for tops and branches. None of these methods were satisfactory.

For a 2-week period a timber cutter was added to the landing crew to buck off tops and branch stubs. It was not possible to keep this man fully occupied, so bucking and limbing were shifted back to the stump area as in regular operations.

Even when tops and branches were yarded separately, additional delays occurred as this material accumulated at the landing area. Operations then had to be halted while the area was cleared, either with the loader or with a crawler tractor.

After a number of these trials, the operator shifted to two-stage yarding, and completed the three units. In this method all the regular logs were yarded first; then the entire setting was relogged for the cull logs, tops, chunks, and branches. Some of the larger cull logs were yarded during the first stage. Most of the second stage yarding was done by a separate yarder and a separate crew.

Short pieces and branches were choked in bundles, and at times a second crew was used to pile this material ahead to speed up yarding. However, much breakage of these bundles occurred during inhaul, and some pieces had to be handled two or three times before they reached the landing.

The operator proposed yarding the unutilized material with a mobile yarder positioned in the unit to permit smaller piles and shorter yarding distances. This proposal was not approved because of the fear of soil compaction and its effect on planned reforestation and silvicultural research.

In hindsight, some form of skyline operation would have reduced breakage of tops and branches during yarding, especially if this material were yarded concurrently with regular logs. Also, smaller chokers, including nylon chokers, might have increased efficiency in yarding small material.

RESULTS

Residue Levels

Resulting residue levels for pieces over 9 inches in diameter were mostly well under the maximums allowed (table 2). This was partly due to the requirement that each sampling area meet the specifications--low residue levels could not be balanced with high levels to give an acceptable average. Also, the operator did not want to go back and relog areas not meeting specifications. A third reason was that neither cubic feet nor tons per acre could be adequately visualized nor measured by the operator or crew, and they could not judge their performance until results of the Forest Service measurements were known. For this reason they tended to be conservative and made extra effort to be sure the amount of residue removal was adequat-

Residue levels attained in the 3.1-
minimum specified on Units 1 and 2 be
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3.1- to 9-inch size class.

Table 2--Specified and measured residue levels by diameter class

Cutting unit	1/4 - 3 inch			3.1 - 9 inch			Over 9 inch			Total		
	Specified volume	Measured volume	Standard error 1/	Specified volume	Measured volume	Standard error 1/	Specified volume	Measured volume	Standard error 1/	Specified volume	Measured volume	Standard error 1/
	--Tons per acre--		Percent	--Tons per acre--		Percent	--Tons per acre--		Percent	--Tons per acre--		Percent
1	4-6	5.6	5.6	4-8	2.9	11.6	0	0	--	8-14	8.5	6.1
2	5-9	2/9.1	4.1	6-11	5.2	8.5	<10	4.4	11.9	<30	18.6	5.0
3	8-13	8.5	4.4	8-14	8.4	7.0	<20	9.3	13.2	<47	26.2	6.2

1/Standard error is an estimate of sampling precision. The probablility is approximately 95 percent that the sample mean is within plus or minus twice the standard error from the population mean.

2/Measured residue level of 9.1 tons per acre was judged not a meaningful deviation from the specified level.

Measured residue levels shown in table 2 are the means of 40-point planar intersect samples of the individual sectors of each cutting unit, which ranged from 15 to 20 sectors per unit. Standard errors of the data in individual diameter classes ranged from 4.1 to 13.2 percent. Each sector covered the area yarded by at least one cable yarding road, and all yarding roads were included.

Some of the larger unutilized material was yarded in the main yarding stage, but most was left for the residue yarding stage. The volume of residue was also measured on each unit after the main yarding but before residue yarding; these levels, in material 1/4-inch and larger diameter, were 78.6, 82.6, and 77.7 tons per acre on Units 1, 2, and 3, respectively.

Post-Harvest Reevaluation

The reevaluation team consisted of the same disciplines and nearly the same team members that had made the presale evaluation. After harvest, the team agreed that the desired level represented by Unit 2 should have been slightly lower for the small material and slightly higher for the larger material. They added a recommendation for leaving two or three large pieces per acre 20 inches in diameter or larger not over 10 feet in length, for wildlife use (table 3). They also recommended leaving one or two isolated snags or green trees that could become snags. This recommendation was not included in the consensus due to commitment of the area to research on intensive timber management, and to the presence of many other snags in the adjoining green timber.

The landscape management representative recommended leaving no large residue pieces (over 20 inches in diameter) in the first 100 or 200 feet from main roads, with a gradual increase in amount of all residue sizes permissible beyond the foreground area. He also recommended leaving patches of reproduction where possible, especially to temper the sharp visual effect of abrupt cutting edges as seen from the roads.

Table 3--1977 interdisciplinary team consensus of desired residue level

Diameter class, inches				Slash depth	Duff-litter depth	Duff-litter ground cover
1/4-3	3.1-9	9.1-20	20.1+			
- - - Tons per acre - - -			Pieces per acre <10 ft long	Feet	Inches	Percent
3-6	4-6	5-9	2-3	<0.3	<2-3	<60

Team members expressed concern that the duff-litter layer was surprisingly undisturbed, and that this layer, ranging up to 12-inch depth, was laced with roots which would make planting and hand fire line construction difficult. The team felt that machine piling and burning or broadcast burning would still be desirable additional treatment for these areas. They added to their consensus report a recommendation that average slash depth be not over 0.3 foot, that duff-litter depth be not over 2 or 3 inches, and that the duff-litter ground cover be not over 60 percent.

DISCUSSION

This trial was an effort to focus timber sale planning on land management needs as identified by an interdisciplinary team and to make an operational trial of achieving the specified residue levels, by size class, through the yarding process. These objectives were achieved, but only at considerable expense, as contrasted with alternative treatment by broadcast burning or by machine piling and burning.

Operational Problems

The chief operational problem was the inefficiency of yarding tops, short chunks, and branchwood with large, powerful high-lead equipment. Too many turns broke as they traveled along the ground to the landing. Some form of skyline system would have been able to yard tops intact, with less breakage and rehandling of branches.

The large volume of residue precluded concurrent yarding of residue with the regular logging, unless some means were available to remove each piece of residue as it reached the landing. The possibility of hauling residue to a disposal site was considered in the sale planning stage, but the decision was made to avoid extra handling and to dispose of the residue on its original site.

Lack of Market for Residue

More of the residue might have been utilized for pulpwood chips if the market had remained at its high level existing at the time of sale planning. The chip log market, however, was extremely poor during the operation period; and residue piles at the landings became quite large.

Some use was made of the residue piles by issuing firewood permits to individuals for home use. Commercial firewood dealers inspected the piles but were not interested, partly because most of the material was western hemlock and Pacific silver fir, not very desirable species for commercial firewood.

With no prospect of a market for the residue piles, they were disposed of by burning in late fall of 1976.

Land Management Aspects

An important objective of this trial was to see if the land could be prepared for regeneration without burning. In some places, concentrations of material 1/4 to 3 inches in diameter were too much to plant through; in other places, material 3 to 9 inches in diameter would be a nuisance to planting crews. Also, due to the heavy duff and litter layer of this old-growth timber type a site-preparation treatment before planting was prescribed.

Either broadcast burning or machine piling and burning would have prepared the ground for regeneration with much less effort and expense. Even though results on this site were less than satisfactory from a regeneration standpoint, perhaps conditions would be more favorable for regeneration on other sites having less of a duff-litter layer.

Focusing attention on land management needs brings out the favorable influence of forest residue in giving protection to the soil, protecting seedlings from excessive heat and drying, providing cover for wildlife, and recycling nutrients.

Administration

It is recommended that on an operational basis the interdisciplinary team be made up chiefly of Ranger District personnel, but supplemented where needed to obtain qualified specialists in a particular discipline.

In future sales, residue measurement, too, could be made a responsibility of Ranger District personnel.

CONCLUSIONS

These three study units are case histories; the following conclusions apply only to these units:

1. Yarding of small residue was very inefficient with standard high-lead equipment not designed for this type of service. Operations were slowed by the need for hand piling of broken tops, chunks, and limbs in preparation for yarding, and by such material breaking up as it traveled along the ground during yarding.

2. Residue management had an important role in planning and operation of this timber sale. It focused attention on soil protection, seedling protection, nutrient recycling, provision of cover for wildlife, and reduction of the need for burning.

3. An interdisciplinary team gave an important input to timber sale planning. Their value was in helping to accomplish land management objectives in a positive way, rather than just being concerned with planning treatment after a timber harvest job is done.

4. More trials are needed, especially on steeper ground. Different logging methods and equipment more suitable for handling small material could result in less breakage and less costly yarding.

GPO 990-057